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Use of Stop-Drop Sprays on Apples and Pears

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SUMMARY

Efforts to reduce the economic loss caused by fruit falling from trees at harvest have gained outstanding success with apples and pears.

Four plant growth-regulating compounds in dilute sprays are being widely used by growers to retard the natural loosening of fruit on the tree. Each compound has merits, also limitations, in use.

NAA (naphthaleneacetic acid) controls drop of all commercial varieties of apples and pears. It is the only fruit-sticking chemical found practical for airplane spraying. Its effectiveness is usually no longer than 10 days or 2 weeks.

2,4-D (2,4-dichlorophenoxyacetic acid) controls drop of Winesap and Stayman apples and Bartlett pears. It has such lasting effectiveness that it can be applied 3 to 4 weeks before harvest.

2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and 2,4,5-TP (2,4,5-trichlorophenoxyproprionic acid) control drop of all commercial varieties of apples, but are damaging to pears. Like 2,4-D, their effectiveness is prolonged.

Research has progressively added to understanding of factors that affect success with these preharvest sprays, including: choice of compound; solution strength; timing of application; temperature; moisture; and avoidance of such side effects as overripening and softening of fruit and damage to foliage and buds.

Information in this report was provided by the Horticultural Crops Research Branch, Agricultural Research Service

USE OF STOP-DROP SPRAYS ON APPLES AND PEARS

Chemical sprays that retard the drop of fruit from apple and pear trees reduce fruit losses at harvest from such high proportions as 20 percent or more to only 5 or 6 percent and frequently less.

The chemicals in these sprays--known as stop-drop sprays--so tighten a tree's hold on its crop that the fruit is not likely to drop even when jolted by ladders or shaken by the wind.

Research is progressively adding to the number of chemicals that can be used to stop the fruit from dropping, and is also determining more specifically their effectiveness on particular varieties, solution strengths, times of application, and such side effects as overripening and softening of fruit and damage to foliage and buds.

Loosening of fruit on a tree is natural in the maturing process. As fruit nears maturity, a callous abscission (separation) layer forms where the fruit stem joins the spur. The callous separates the cells holding stem to spur, and from then on the weakly-held fruit may fall.

Drop may be increased if trees are deficient in boron or magnesium, or if they have too little moisture. Trees heavily fertilized with nitrogen often drop more fruit than trees moderately fertilized.

Growth-regulating chemicals that can retard the formation of the abscission layer have been tried on some fruits besides apples and pears. Thus far they have shown little value in protecting peaches from drop. Some compounds have prevented premature dropping of prunes and apricots, if applied early--at the pit-hardening stage. On citrus fruits, preharvest sprays have been effective under some conditions. However, the outstanding success of preharvest sprays has been attained in saving apples and pears--two fruits extensively damaged by drop.

All varieties of apples and pears are subject to drop, some more than others. Loss has been serious enough in apples to lead growers of all commercial varieties to adopt preharvest spraying, except in the case of early summer apples which are picked before they are eating ripe. Among pears, Bartletts are most likely to drop, Bosc next. Other pear varieties may not drop seriously enough to require a preharvest spray. Protection against dropping by a preharvest spray may be gained at a cost of around $4 an acre (a rough approximation) for cost of material and application.

Before fruit-sticking sprays were available, apple and pear growers knew, and occasionally practiced, one drastic means of forestalling drop loss. This was to pick early, even though fruit might not have attained its best value in size, color, or storage quality.

OVERCOMING THE PROBLEM

. . .With NAA

Use of a plant-growth regulator to control fruit drop became practical in 1939 when horticulturists at the U.S. Department of Agriculture's Plant Industry Station reported that NAA--naphthaleneacetic acid or its salts or esters--would retard the drop of apples. Soon after, NAA was found effective for retarding the drop of Bartlett pears, through experiments at the California Agricultural Experiment Station.

The chief limitation of the NAA compounds is their brief effectiveness, which usually lasts not more than 10 days or 2 weeks. When the effect wears off, fruit on the tree is likely to drop quickly, often in quantities overnight. Repeating the spray to prolong effectiveness has not proved very helpful.

Despite its limitations, NAA has, from the first, been widely used and valued by growers. It is still chosen in some situations. It is the only fruit-sticking chemical found practical for airplane spraying.

. . .With 2,4-D, 2,4,5-T, and 2,4,5-TP

Initial success of NAA has led to many further experiments with growth-regulating chemicals in a search for longer-lasting control of fruit drop. Thus far, 3 phenoxy compounds have proved their practical value. They can be applied conveniently early--3 to 4 weeks ahead of the rush work of harvest--with expectation of controlling drop during harvest, even if picking takes longer than the usual 3 weeks. Each of the longer-lasting compounds has some limitations in use: One protects only certain apple and pear varieties; others protect the commercial varieties of apples but not pears. None is satisfactory for spraying from the air.

Experiments with 2,4-D (2,4-dichlorophenoxyacetic acid) at USDA's Plant Industry Station, Beltsville, Maryland, demonstrated strikingly that the growth-regulating chemicals can be specific in their fruit-sticking effect. This chemical controls drop of 2 apple varieties--Winesap and Stayman--and also of Bartlett pears. But when 2,4-D was tried on apples other than Winesap and Stayman, the trees dropped fruit almost as though no treatment had been applied.

More recently, research initially begun at the Agricultural Experiment Station of Cornell University has established wide usefulness of the phenoxy compounds 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and 2,4,5-TP (2,4,5-trichlorophenoxyproprionic acid). Both can be used in salt and amide forms as well as the acid. Both are satisfactory for sticking fruit on all commercial varieties of apples. Neither of these compounds, however, is suitable for pears because it may damage foliage and fruit.

SPRAYING VERSUS DUSTING

Spraying is commonly preferred to dusting as a means of applying stop-drop chemicals. Ground spraying is somewhat more effective than spraying from airplane. For ground spraying, growers use any of the conventional machines used in pest control.

Dusting as an alternative to spraying has been included in stop-drop experiments and often is as effective as spraying. Dusting is effective only when there is enough moisture on foliage to make a deposit stick.

SPRAY SOLUTIONS AND THEIR USE

Much has been learned about advantageous use of successful stop-drop chemicals. Following are present practices and principles, based on advances in research:

Suiting Chemical and Dilution to Use

Success with stop-drop spraying calls for selection of a suitable chemical and in the weakest solution that will be effective. The weakest solution that gives stop-drop control is the most advantageous on several important counts: It is economical. It is less likely to cause side effects, such as overripening and softening of fruit, or damage to buds and foliage. An over-strong solution can make fruit hard to pick.

NAA can be used on any of the commercial varieties of apples and pears.

For apples, an NAA stop-drop ground spray is generally kept to a standard strength of 10 p.p.m. (parts per million).

For pears, an NAA ground spray containing 5 p.p.m. is adequate. Stronger solutions may cause overripening.

2,4-D is useful only for Winesap and Stayman apples and Bartlett pears.

To avoid tree injury, concentrations of 2,4-D should be kept at 5 to 7 p.p.m. for Winesap and Stayman apples--never more than 7; for Bartlett pears, usually 2 to 3 p.p.m.--never more than 5.

2,4,5-T and 2,4,5-TP can be used on any of the commercial varieties of apples, but should not be used on pears.

A rate of 20 p.p.m. is considered the maximum strength of 2,4,5-T and 2,4,5-TP that can be used without causing apples to ripen and soften undesirably. For some varieties, weaker solutions have proved adequate--for example: 10 p.p.m. for Delicious and Winesap; 15 p.p.m. for Golden Delicious, Stayman, and York. For Rome, 20 p.p.m. are needed.

Quantity

Quantity of any solution applied should be sufficient to cover trees thoroughly and evenly. In early research it was supposed that spray must contact fruit stems in order to be carried to the stem-spur junction. Later work, however, has shown that foliage is the main transmission route.

To spray an acre of large trees from the ground with any of the dilute fruit-sticking solutions requires from 600 to 1,000 gallons.

With air-blast spray equipment, it is possible to apply the stop-drop chemicals as "concentrate" sprays. With this equipment, concentrations may be 4 to 6 times as strong as a dilute spray, and the liquid per acre is reduced accordingly.

Timing

How far ahead of harvest to apply a fruit-sticking spray depends on the chemical chosen.

Proper timing allows for a lag of some days after spraying, in which period the chemical is taking effect. NAA requires about 3 days to become effective; 2,4-D about 10 days; 2,4,5-T and 2,4,5-TP about a week.

Since NAA is dependable for no more than 10 days or 2 weeks, a preharvest NAA spray needs to be timed closely, to take effect just when drop is expected to start.

2,4-D and 2,4,5-T and 2,4,5-TP may be applied 3 or 4 weeks before harvest, which is often convenient timing for work management.

Successful spray application is timed to keep within certain stages of plant growth. Spray applied too early may increase a chemical's effect on ripening, and fruit may be overripe when picked. A stop-drop spray is too late and is wasted if applied after the abscission process is already under way, because then the chemical cannot take effect. Spray is also too late to give good effect if applied after foliage is old and faded from frost or other cause.

Combining Treatments

Several varieties planted together can frequently be given drop protection by one preharvest spraying--provided the same chemical and the rate of application are suitable for all.

A dual-purpose spray--in which a stop-drop chemical has been added to material for plant disease or pest control--is often less satisfactory than a stop-drop chemical sprayed separately, and especially so if the other spray material contains lime.

Climate Considerations

Temperature makes some difference in results achieved with preharvest sprays, and should be considered in planning their use. A relatively warm temperature, 70° F. or higher, at spraying time is an advantage, because the chemical will be absorbed more readily than when weather is cool. At warm temperatures the chemical will also take effect faster. Once a stop-drop chemical has become effective, temperature changes do not further alter its potency to any extent.

Considerable moisture from dew, fog, or rain is ordinarily an aid to the potency of the chemicals. Lack of moisture, contrariwise, lowers their efficiency. Occasionally, the unexpected happens, as when McIntosh apple trees in Northeast orchards dropped fruit badly in 1955, when the growing season was rainy. Such situations are a reminder that, useful as the stop-drop chemicals are, their action is not completely understood.

Airplane Spraying

Airplane spraying is ordinarily a custom arrangement with firms doing this work. The method offers advantages of speed and convenience for growers who have large fruit plantings. Thousands of acres of apples and pears are given preharvest spray from the air annually in the extensive fruit-growing centers of the Northwest.

For airplane spraying the only practical stop-drop chemical is NAA. Any drift from airplane applications of 2,4,5-T or 2,4,5-TP that might reach pear trees could damage foliage and fruit.

NAA sprayed on apples and pears by plane is prepared in concentrated form. The same quantity of material that would be dissolved in 1,200 gallons of water for ground spray is put into 5 gallons of oil emulsion for plane spraying. When the spray is diffused by air-blast, the air carries the spray in fine mist to the trees.

FURTHER RESEARCH ADVANCEMENT

Continued research with stop-drop chemicals applied to apples and pears is aimed chiefly at 2 major goals:

1. To find more effective compounds . . . serving many varieties, possibly with greater economy and convenience.

2. To understand more accurately the physiological processes involved and to learn whether it is possible to predict biological effects of different growth regulators from their chemical structure.